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(54) Flexible protective cladding

(57) The flexible protective cladding comprises a plurality of flexibly linked annuli (11) in which each annulus carries a plate (12) whose periphery overlaps the edge of the associated annulus. The links (2) between annuli permit movement up to the diameter of one annulus in the plane formed by the annuli. The plates on alternate annuli are located on opposite surfaces of the annuli. Gaps between upper and lower plates may be filled by discs 16. Each annulus may be linked to four other annuli disposed at approximately 90° intervals around its periphery. The links between annuli in assembled cladding may pass transversely across each other at regular intervals. Alternatively the links may be formed as simple loops, each one associated with a single annulus, whose ends are attached to the ends of other similar loops to link the annuli. The links may take the form of straps which thread through two annuli and whose ends are joined by a single fixing element.

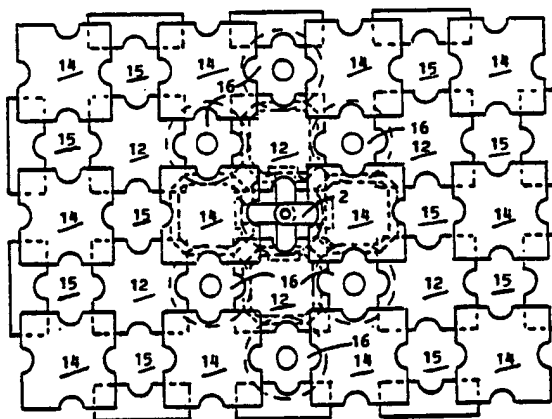
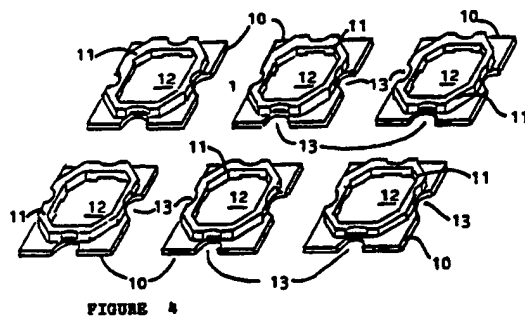


FIGURE 5

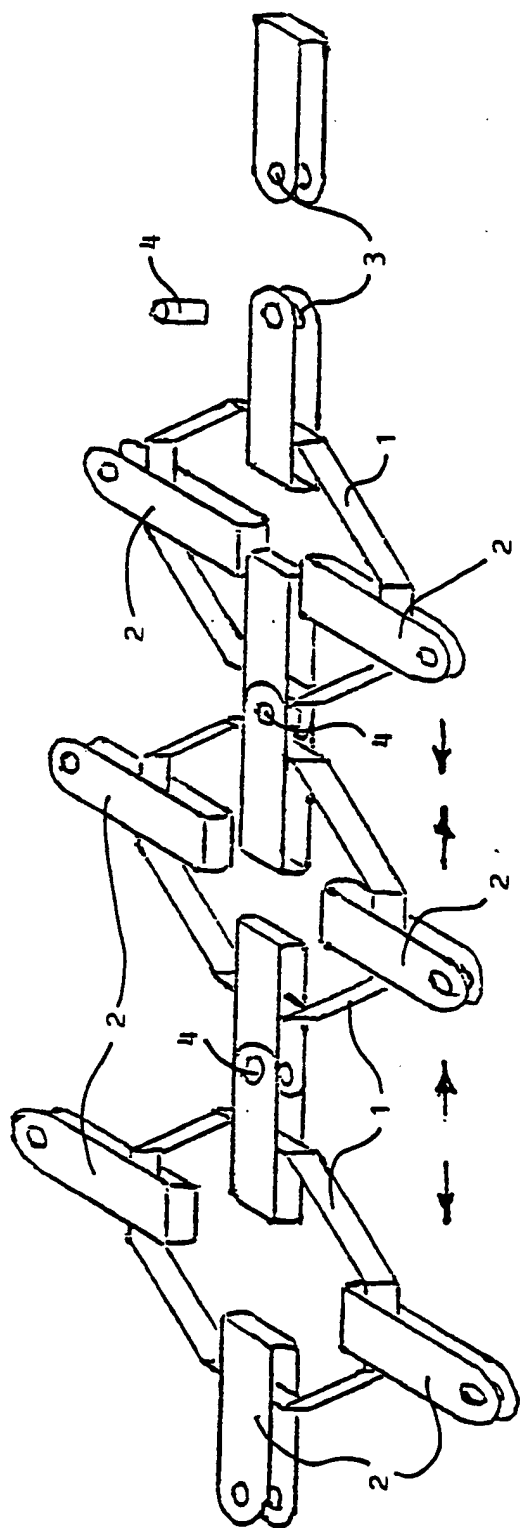


FIGURE 1

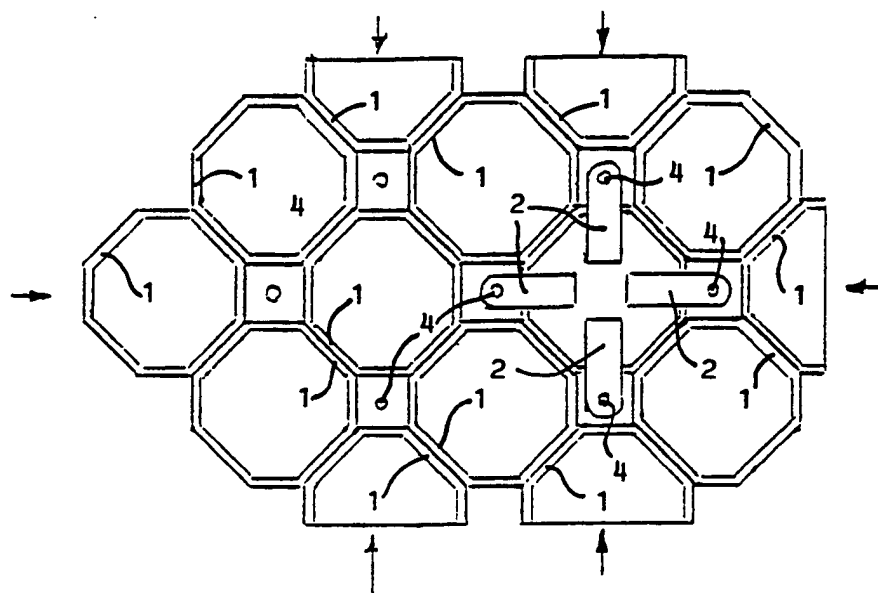


FIGURE 2

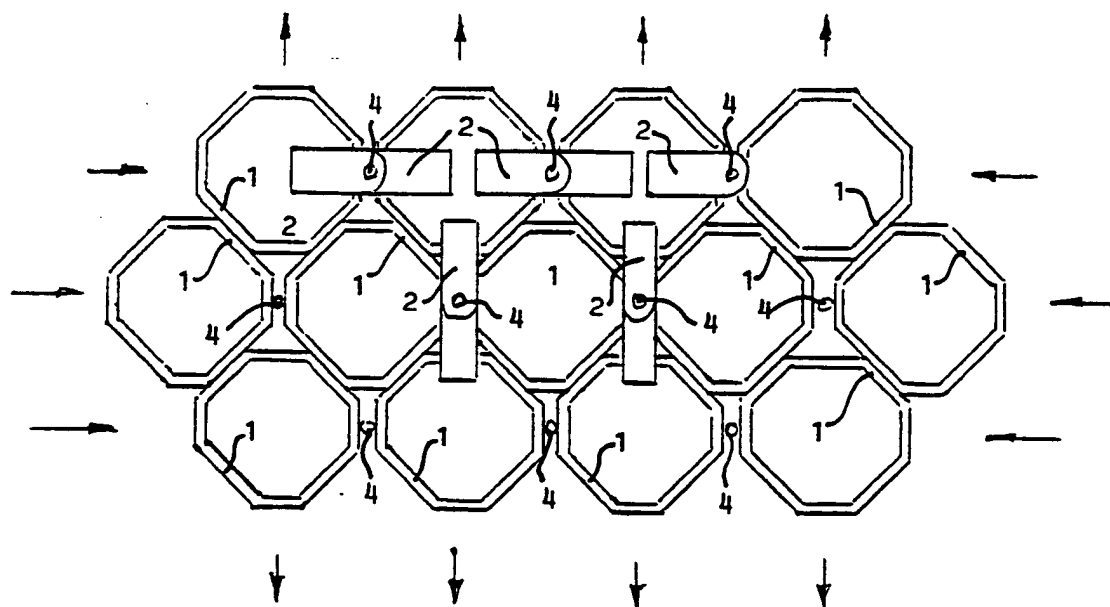
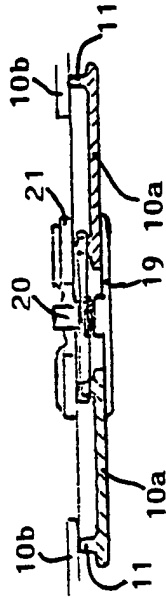
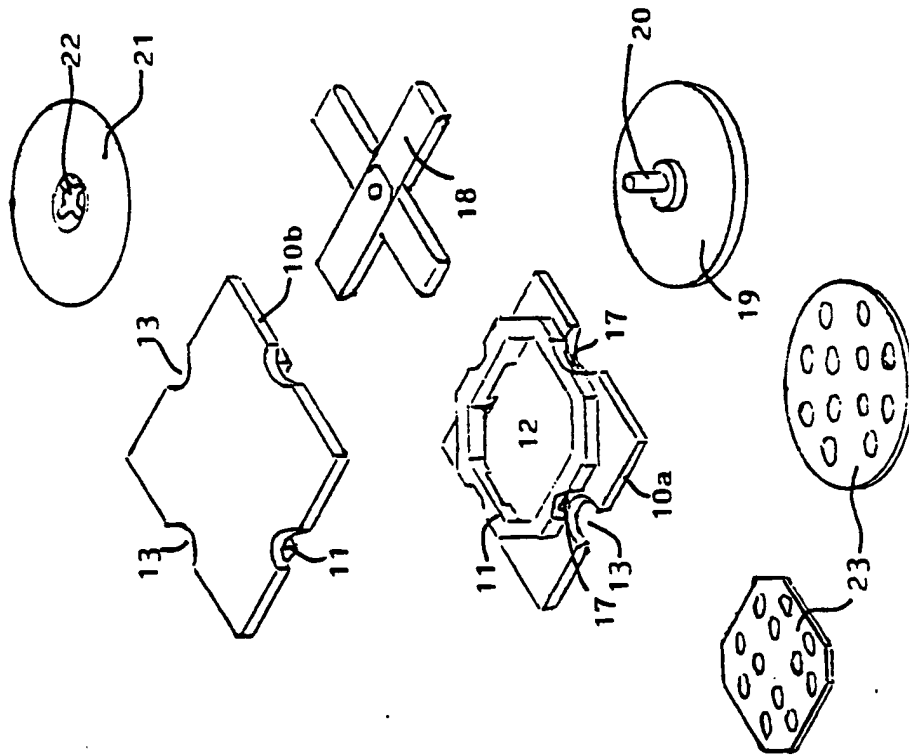


FIGURE 3



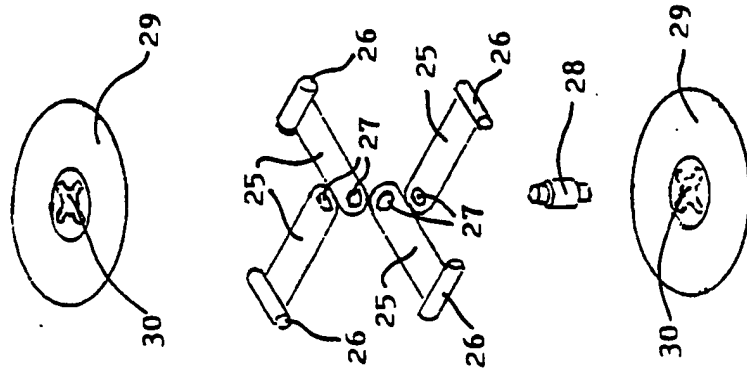


FIGURE 7

FLEXIBLE PROTECTIVE CLADDING

This invention relates to flexible protective cladding and more particularly to cladding that may be used as protective
5 ive body armour to reduce impact damage from knives, bullets and other concentrated energy sources.

Armour for protecting the human or animal body from impact damage has been available for centuries. In general such
10 armour provided protection from daggers, swords and arrows. However when the armour has sufficient thickness to provide adequate protection the mobility of the wearer is severely curtailed. Under conditions of ritual warfare such restrictions were generally acceptable.

15

In recent years protection for military personnel has been provided by aramid fibre cloth and ceramic plates. The widespread use of small weapons by criminals and other offensively minded people has led to the need for light
20 weight, very flexible, protective cladding which can be worn unobtrusively by police, ambulance service, fire service and other personnel throughout their normal periods of duty.

25 WO 92/00497 and GB 9500041 disclose flexible protective cladding comprising sets of overlapping plates in which the surface is free of interstices capable of allowing the passage of a knife point or spike. Responsive body movement following an attack can increase or decrease the
30 area of the body exposed; for example, the distance between the armpit and hip bone when the body bends sideways from one side to the other, distance from throat to groin when standing rather than sitting or crouching, distance from nape of neck to waistline. Such changes when the above
35 described cladding is worn, especially when made rapidly,

can create strains on the abdomen and other parts of the body.

Some of the distance variation may be accomodated when
5 wearing linked body armour by the use of elastic supporting straps and the use of separate panels of cladding which can move over the main panel.

It is an object of the present invention to provide
10 flexible protective cladding which will permit substantial changes in area without affecting its protection to the wearer.

It is a further object to provide protective body armour
15 fabricated from the cladding of the invention that can be worn for long periods of duty.

It is also an object to provide flexible protective
cladding which can withstand penetration by knives and
20 other concentrated energy sources.

According to the present invention there is provided flexible protective cladding comprising a plurality of flexibly linked annuli, in which each annulus carries a plate whose
25 periphery overlaps the edge of the associated annulus, the links between annuli permitting movement up to the diameter of one annulus in the plane formed by the annuli, and in which the plates on alternate annuli are located on opposite surfaces of the annuli.

30 In a preferred embodiment each annulus is linked to four other annuli disposed at approximately 90° intervals around its periphery. The links between annuli in assembled cladding will pass transversely across each other
35 at regular intervals. The crossing preferably carries one

or more discs combined with a linking pin.

The links between the annuli are preferably formed by strips of a metal or a strong flexible polymeric material
5 such as a polyamide, polyester, polycarbonate, poly-
urethane, polycarbonate or polyacetal. The links may be
formed as simple loops, each one associated with a single
annulus, whose ends are attached to those of other similar
10 loops to link the annuli. Alternatively the links may
take the form of straps which thread through two annuli and
whose ends are joined by a single fixing element.

The plate carried by each annulus is preferably square,
hexagonal, octagonal or other regular shape so that when
15 the plates are urged together in a plane they form a
surface free from interstices. The annulus and the plate
are preferably an integral unit formed together from the
same blank. The plates may be formed from metal or a high
impact resistant polymeric material or composite. Aluminium
20 is the preferred metal when the cladding is to be worn as
it provides an excellent combination of strength, density
and cost. Cladding made using this metal can be worn
comfortably without an undue weight burden. The plates
will prevent the penetration of knife thrusts and bullets
25 from small calibre hand guns.

The annuli and associated plates are arranged in a pattern
with alternate plates facing inwardly and outwardly. The
overlap between the plates will cover a substantial portion
30 of the interstices between each set of plates when the
cladding is extended. The central portion of each such
interstice will be filled with the discs associated with
the locking pin for the linking members. The discs may be
round, square or other shape that ensures that the
35 interstice between the plates is always covered.

When the cladding is used as body armour it may be encased with a layer or layers of a textile covering, such as an aramid fibre cloth, for comfort and to prevent interaction with other clothing. Body armour may be formed from the
5 cladding according to the invention alone or in combination with panels of cladding of the type described in patent application 9400025. The latter form of cladding may be placed over the front central portion of the armour where knife or bullet impact is most frequent.

10

After impact with a knife or bullet the linking members and the plates at the point of impact may be permanently deformed or distorted. The preferred method of construction using a series of simple components enables
15 cladding to be repaired easily by replacement of the damaged portions.

In order that the invention may be clearly understood it will now be described with reference to the accompanying
20 drawings in which:

Figure 1 is a schematic view of a set of linked annuli for use in cladding according to the invention,

Figure 2 is a plan view of the annuli used in the cladding according to the invention when in their closed form,

25 Figure 3 is a plan view of the annuli shown in Figure 2 when laterally extended,

Figure 4 is a schematic view of a set of annuli with attached square plates used to form cladding according to the invention,

30 Figure 5 is a plan view of cladding according to the invention using the annuli of Figure 4 with a top layer of identical plates inverted to form a top and bottom surface of square plates overlapping a set of annuli which are linked to form a common plane,

35 Figure 6 shows the components forming the cladding of

Figure 5, and
Figure 7 an alternative embodiment of the linking
components forming the cladding of Figure 5.

5 Each member of a set of annuli 1, see Figure 1, carries
four linking members 2 spaced at 90° intervals around the
periphery. The members 2 are pierced at their extremities
by apertures 3 which enable them to be joined by pins 4.
It will be seen that the links permit a range of lateral
10 movement by the annuli. When laterally extended the
members 2 are retained by the inner surface of the annuli 1
while when laterally compressed the outer peripheries of
the annuli 1 are in contact with the pins 4 and the major
portion of the members 2 is contained within the interior
15 of the annuli 1.

The annuli used in the cladding according to the invention
are linked to form a plane, see Figure 2 in which the
annuli 1 are shown in their compact form. The outer edges
20 of the annuli touch and the joint between the links 2,
formed by the pins 4, lies in the interstices. The outer
edges of the annuli can slide against each other so that
when assymetric lateral forces are applied to the linked
annuli, see Figure 3, can slide against each other and can
25 allow the associated cladding to conform to the contours of
wearer.

A set of square plates 10 each having integral annulus 11
fixed to their under surface 12 is shown in Figure 4. The
30 sides of the plates carry a small cut out portion 13 to
accomodate the joint between the linking members. The
plates 10 may be assembled into cladding, see Figure 5, by
inverting alternate plates so that the upper surfaces 14
form a primary shield while the undersurfaces 12 form a
35 secondary shield where exposed through gaps in the plane of

the primary plates. The plates 10 are connected using links in the manner previously described. The gaps 15 between the upper and lower sets of plates 10, corresponding to the joints between link members 2 formed by the pin 4, are filled by discs 16 attached to each end of the upper and lower ends of the pins 4.

The components used to form the embodiment of the cladding illustrated in Figure 5 are shown in detail in Figure 6.

10 Two plates 10 are shown facing upwardly 10a and downwardly 10b. Each plate carries an integral annulus 11 having slots 17 spaced at 90° intervals around the periphery. Four linking members 18 are shown assembled in a cruciform manner. When fully assembled the linking members 18 would

15 be passed through the slots 17 in the annuli 11 of the associated plates 10.

A lower disc 19 carries a pin 20 which fits the aperture at the centre of the cruciform assembly of linking members 18 and holds them in position. A second disc 21 has a

20 central aperture 22 with gripping means so that when the disc 21 is forced over the pin 20 it will be locked in position. The discs 19 and 21 will be overlapped to a large extent by the periphery of the plate 10 which extends

25 beyond the annulus. The exposed portions of the surface of the discs 19 and 21 will ensure that the interstices between the plates 10 in assembled cladding will be covered. The cladding therefore provides a protective surface whether stretched or in its most compact form.

30 In order to increase the impact strength of the cladding hardened steel discs 23 may be fitted to the plates 10 and the discs 19.

35 In a further embodiment, see Figure 7, linking members 25

are formed as straps which slide through the slots in the annuli and which have a thickened end piece 26. The members 25 are pierced at their extremities by apertures 27 which enable them to be joined by a pin 28. The ends of
5 the pin 28 are reduced in diameter to accomodate a disc 29 on each. The discs 29 are retained on the ends of the pin 28 by gripping means located in a central aperture 30.

CLAIMS

1. Flexible protective cladding comprising a plurality of flexibly linked annuli, in which each annulus carries a plate whose periphery overlaps the edge of the associated annulus, the links between annuli permitting movement up to the diameter of one annulus in the plane formed by the annuli, and in which the plates on alternate annuli are located on opposite surfaces of the annuli.
2. Flexible protective cladding as claimed in claim 1 in which each annulus is linked to four other annuli disposed at approximately 90° intervals around its periphery.
3. Flexible protective cladding as claimed in claim 2 in which the links between annuli in assembled cladding pass transversely across each other at regular intervals.
4. Flexible protective cladding as claimed in claim 3 in which the links between the annuli are formed by strips of a metal or a strong flexible polymeric material.
5. Flexible protective cladding as claimed in claim 4 in which the polymeric material is a polyamide, polyester, polycarbonate, polyurethane, polycarbonate or polyacetal.
6. Flexible protective cladding as claimed in claim 4 in which the links are formed as simple loops, each one associated with a single annulus, whose ends are attached to the ends of other similar loops to link the annuli.
7. Flexible protective cladding as claimed in claim 4 in which the links take the form of straps which thread through two annuli and whose ends are joined by a single fixing element.

8. Flexible protective cladding as claimed in any of the preceding claims in which the plate carried by each annulus is square, hexagonal, octagonal or other regular shape so that when the plates are urged together in a plane they
5 form a surface substantially free from interstices.

9. Flexible protective cladding as claimed in any of the preceding claims in which the annulus and the plate are an integral unit formed together from the same blank.

10
10. Flexible protective cladding as claimed in any of the preceding claims in which the plates are formed from metal or a high impact resistant polymeric material or composite.

15 11. Flexible protective cladding as claimed in claim 10 in in which the plates are formed from metal

12. Flexible protective cladding as claimed in claim 11 in which the plates are formed from aluminium.

20
13. Flexible protective cladding as claimed in any of the preceding claims in which the annuli and associated plates are arranged in a pattern with alternate plates facing inwardly and outwardly.

25
14. Flexible protective cladding as claimed in claim 13 in which the overlap between the plates covers a substantial portion of the interstices between each set of plates when the cladding is extended.

30
15. Flexible protective cladding as claimed in claim 14 in in which the central portion of each interstice is filled with a disc associated with a locking pin for the links.

35

16. Flexible protective cladding as claimed in claim 15 in which the discs are round, square or other shape that ensures that the interstice between the plates is always filled.

5

17. Flexible protective cladding as claimed in any of the preceding claims in which the cladding is encased with a layer or layers of a textile covering.

10 18. Flexible protective cladding as claimed in claim 17 in which the textile covering is an aramid fibre cloth.

19. Flexible protective cladding as claimed in claim 1 and as herein described.

15

20. Flexible protective cladding as herein described with reference to the accompanying drawings.

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Patents Act 1977
Examiner's report to the Comptroller under Section 17
(The Search report)

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Relevant Technical Fields

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(ii) Int Cl (Ed.6) F41H 1/02, 5/00, 5/02, 5/04, 5/013

Search Examiner
 R J MIRAMS

Date of completion of Search
 14 JUNE 1995

Databases (see below)

(i) UK Patent Office collections of GB, EP, WO and US patent specifications.

(ii) ONLINE: WPI, CLAIMS

Documents considered relevant following a search in respect of Claims :-
 1 TO 20

Categories of documents

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| <p>X: Document indicating lack of novelty or of inventive step.</p> <p>Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.</p> <p>A: Document indicating technological background and/or state of the art.</p> | <p>P: Document published on or after the declared priority date but before the filing date of the present application.</p> <p>E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.</p> <p>&: Member of the same patent family; corresponding document.</p> |
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